A Next Generation Air Monitor: Combining Orion and ISS Requirements for a Common Major Constituent Analyzer

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ABSTRACT:

The Major Constituent Analyzer (MCA) is a mass spectrometer-based instrument designed to provide critical monitoring of six major atmospheric constituents; nitrogen, oxygen, hydrogen, carbon dioxide, methane, and water vapor on-board the International Space Station. The analyzer has been an integral part of the Environmental Control and Life Support System (ECLSS) since the station went on-line. The Orion Air Monitor (OAM) was derived from the MCA and heavily optimized for reduced mass, lower power, faster water vapor response, and maintenance-free operation. The resulting OAM is approximately the size of the analyzer portion of the MCA, orbital-replacement unit 02 (ORU 02), while incorporating the functions of three other modules: Data Processing and Communication (ORU 01), Verification Gas Assembly (ORU 08), and Low Voltage Power Supply (ORU 04).

The overlap in MCA and OAM requirements makes it possible to derive a common Air Monitor design that spans both applications while minimally impacting the weight and power limits imposed by the Multipurpose Crew Vehicle (MPCV). Benefits to ISS include the retirement of ORUs 01, 04, and 08, reducing up-mass and eliminating EEE parts obsolescence issues through the extended ISS mission phases. Benefits to MPCV and future deployed habitats under the Constellation program include greater interchangeability across ECLSS subsystems.

This paper discusses the results of the requirements development study, where a superset of ISS and Orion air monitoring requirements were distilled; evaluated against increases in OAM functionality, mass, and power; and traded-off where possible using simple operating mode modifications. A system architecture and preliminary design addressing the common requirements will be presented.